

Applicati n No.: 10/065,803

Docket No.: JCLA9605-R

REMARKS**Present Status of the Application**

The Office Action rejected all presently-pending claims 1, 3-10, 12-17. Specifically, the Office Action rejected claims 1, 5-9 under U.S.C. 103(a) as being unpatentable over Ho (US 6,184,138) in view of Zhao (US 6,100,184, newly cited). The Office Action rejected claims 3 and 4 under 35 U.S.C. 103(a) as being unpatentable over Ho and Zhao and further in view of Mandal (US 6,541,367). The Office Action rejected claims 10, 12-14 and 17 under 35 U.S.C. 103(a) as being unpatentable over Mandal and Zhao. The Office Action also rejected claims 15 and 16 under 35 U.S.C. 103(a) as being unpatentable over Mandal and Zhao and further in view of Ho.

Applicants have canceled claims 3 and 12 and amended claims 1, 4, 6, 10, 13 and 16. After entry of the foregoing amendments, claims 1, 4-10, 13-17 remain pending in the present application, and reconsideration of those claims is respectfully requested.

Discussion of Office Action Rejections

Applicants respectfully traverse the rejection of claims 1 and 5-9 under 103(a) as being unpatentable over Ho (US 6,184,138) in view of Zhao (US 6,100,184) because a prima facie case of obviousness has not been established by the Office Action.

To establish a prima facie case of obviousness under 35 U.S.C. 103(a), each of three requirements must be met. First, the reference or references, taken alone or combined, must

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teach or suggest each and every element in the claims. Second, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to combine the references in a manner resulting in the claimed invention. Third, a reasonable expectation of success must exist. Moreover, each of the three requirements must "be found in the prior art, and not be based on applicant's disclosure." See M.P.E.P. 2143, 8th ed., February 2003.

The present invention is in general related a gap-filling process as claim 1 recites:

Claim 1. A gap-filling process, comprising the steps of:

providing a substrate having a dielectric layer thereon, wherein the dielectric layer has an opening therein;

forming a gap-filling material layer over the dielectric layer and inside the opening, *wherein material constituting the gap-filling material layer is a photoresist material or a bottom anti-reflection coating material;*

removing a portion of the gap-filling material from the gap-filling material layer to expose the dielectric layer; and

conducting a gap-filling material treatment for forming a protective layer on an exposed surface of the gap-filling material layer, wherein the protective layer is not formed over the entire substrate but formed on the exposed surface of the gap-filling material layer;

wherein the gap-filling material treatment includes conducting an ultra-violet curing or a chemical immersion.

Ho discloses a method of forming a dual damascene structure comprising forming a dual damascene opening 14 in a dielectric layer 16. Then, filling a material layer 24 such as a spin-on material, SOG or polyimide into the opening 14. An etching step or a CMP is performed to remove a portion of the material layer 24. Thereafter, a protective layer 30 is formed over the substrate 10. The protective layer is typically deposited over the entire surface of the substrate (col 8, lines 7-12). However, the protective layer of claim 1 of the present invention is formed

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on the exposed surface of the gap-filling material layer but not formed over the entire surface of the substrate. In addition, the protective layer 30 of Ho is formed by a deposition (col. 8, lines 5-6). The protection layer in claims 1 of the present invention is formed by conducting an ultra-violet curing or a chemical immersion to the gap-filling material. Ho does not teach or suggest the method for forming the protection layer as claim 1 disclosed.

The Office Action points out that Ho does not disclose wherein the protective layer is not formed over the entire substrate but formed on the exposed surface of the gap-filling material layer. Zhao discloses the protective layer is not formed over the entire substrate but formed on the exposed surface of the gap-filling material layer (Fig. 16). However, the protective layer 34 of Zhao is formed by a selective deposition (col. 10, lines 24-26). Zkao does also not teach or suggest the method for forming the protection layer is an ultra-violet curing or a chemical immersion. Hence, Zkao can not cure the deficiencies of Ho.

For at least the foregoing reasons, Applicants respectfully traverse the rejection of claim 1 under 35 U.S.C. 103(a), as being anticipated by Ho in view of Zhao because a prima facie case of obviousness has not been established by the Office Action. For the at least same reason, dependent claims 4-9 patently define over the prior art as well.

Applicants respectfully traverse the rejection of claims 3 and 4 under 35 U.S.C. 103(a) as being unpatentable over Ho and Zhao and further in view of Mandal (US 6,541,367) because a prima facie case of obviousness has not been established by the Office Action.

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Applicants first submit that, as disclosed above, independent claim 1 is not disclosed by Ho in view of Zhao, from which claims 3, 4 depend. Mandal discloses that the protective layer is formed by a plasma assisted chemical vapor deposition. However, Mandal does not teach or suggest that the method for forming the protection layer is an ultra-violet curing or a chemical immersion. Hence, Mandal can not cure the deficiencies of Ho in view of Zhao as above discussed.

Applicants respectfully traverse the rejection of claims 10, 12-14 and 17 under 35 U.S.C. 103(a) as being unpatentable over Mandal and Zhao because a prima facie case of obviousness has not been established by the Office Action.

Claim 10. (currently amended) A gap-filling process for fabricating a dual damascene structure, comprising the steps of:

providing a substrate;

sequentially forming a protective layer, a first dielectric layer, an etching stop layer, a second dielectric layer and a cap layer over the substrate;

forming a via opening passing through the first dielectric layer, the etching stop layer, the second dielectric layer and the cap layer;

forming a gap-filling material layer over the cap layer and inside the via opening, *wherein material constituting the gap-filling material layer is a photoresist material or a bottom anti-reflection coating material;*

removing a portion of the gap-filling material from the gap-filling material layer to expose the cap layer; and

conducting a gap-filling material treatment for forming a protective layer on an exposed surface of the gap-filling material layer, wherein the protective layer is not formed over the entire substrate but formed on the exposed surface of the gap-filling material layer;

wherein the gap-filling material treatment includes conducting an ultra-violet curing or a chemical immersion.

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Mandal also discloses a method of forming a dual damascene structure comprising forming a dual damascene opening 520 in a ILD layer and filling a Cu layer 524 into the dual damascene opening 520. The Cu layer 524 is planarized, and then a capping layer 518 (used as a protective layer) is deposited over the substrate by plasma assisted chemical vapor deposition of silicon oxide, silicon nitride, silicon oxynitride or hydrogenated silicon carbide (col. 10, lines 9-12). The protective layer 518 is formed over the entire substrate (Fig 8H). The material filled into the opening is Cu. However, in claim 10 of the present invention, the protective layer is not formed over the entire substrate. The material filled into the opening is a photoresist material or a bottom anti-reflection coating material. The method of forming the protective layer is an ultra-violet curing or a chemical immersion.

As above discussed, the protective layer of Zhao is formed by a selective deposition (col. 10, lines 24-26). Zhao does also not teach or suggest the method for forming the protection layer is an ultra-violet curing or a chemical immersion. Hence, Zhao can not cure the deficiencies of Mandal.

For at least the foregoing reasons, Applicants respectfully traverse the rejection of claim 10 under 35 U.S.C. 103(a), as being anticipated by Ho in view of Mandal because a prima facie case of obviousness has not been established by the Office Action. For the at least same reason, dependent claims 13-17 patently define over the prior art as well.

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Applicants respectfully traverse the rejection of claims 15 and 16 under 35 U.S.C. 103(a) as being unpatentable over Mandal and Zhao and further in view of Ho because a prima facie case of obviousness has not been established by the Office Action.

Applicants first submit that, as disclosed above, independent claim 10 is not disclosed by Mandal in view of Zhao, from which claims 15, 16 depend. As above discussed, Ho does not teach or suggest that the method for forming the protection layer is an ultra-violet curing or a chemical immersion. Hence, Ho can not cure the deficiencies of Mandal in view of Zhao as above discussed.

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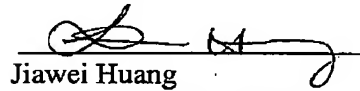
CONCLUSION

For at least the foregoing reasons, it is believed that the pending claims 1, 4-10, 13-17 and 17 are in proper condition for allowance. If the Examiner believes that a telephone conference would expedite the examination of the above-identified patent application, the Examiner is invited to call the undersigned.

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